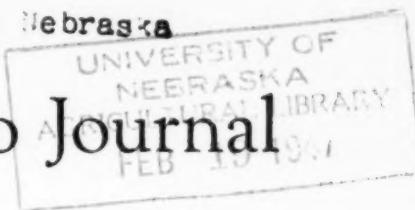


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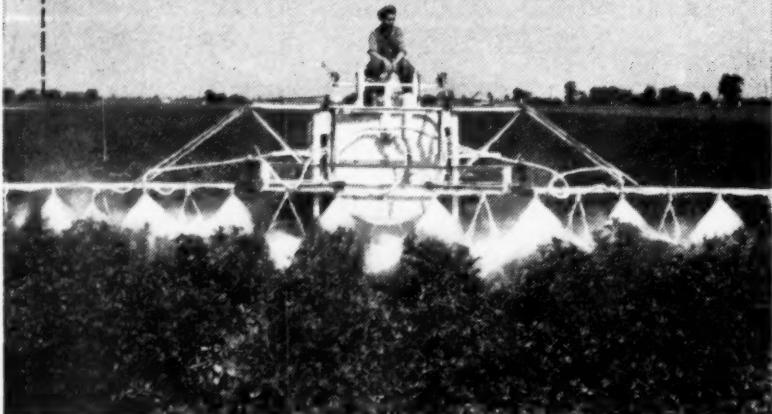
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DISCOLORATION OF POTATOES AFTER COOKING AS RELATED TO THEIR COMPOSITION*

SELMA L. BANDEMER, P. J. SCHABLE AND E. J. WHEELER

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Some potatoes develop a grey, blue, or black discoloration during cooking, or upon standing after cooking. This condition has been reported from various regions in the United States and in many countries throughout the world and is particularly serious some years. It impairs the attractive appearance of cooked potatoes but probably does not affect their nutritional value.

The discoloration occurs usually toward the stem end of the tuber but frequently is more generally diffused. The high temperature involved in cooking suggests that it is non-enzymatic in character. Tinkler (8) concluded that the discoloration may be caused by oxidation of a phenol or amine. Workers in the Bureau of Home Economics (2) attributed the change to compounds of the catechol type of tannins.

Compared with normal potatoes, those which discolor after cooking contain in the raw state higher amounts of free amino acids and a more unstable protein content (9). Tottingham, Nagy, and Ross state that boiling releases tyrosine and tryptophane which are oxidized by heat-stable catalysts to melanin pigments. Robison (6) maintains, however, that the color cannot be due to melanin as the latter is quite stable at pH 3.0 whereas the color in potatoes disappears at this pH. She found that the discolored tubers drawn from the same sample con-

*Journal Article No. 840 (N. S.) Michigan Agricultural Experiment Station.

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tained more iron (as extracted by 20 per cent H_2SO_4) than normal ones. Furthermore non-blackening potatoes could be made to blacken by soaking in $FeSO_4$ (iron sulphate) solution, washing, and boiling. She hypothesized that the precursor of the black pigment exists in the raw potato in the form of ferrous iron, bound in a loose complex possibly with protein. This complex is hydrolyzed on boiling and the iron precipitated as a colorless ferrous compound which is gradually oxidized to the black oxide as air penetrates the tissues. This theory supports the observation that discoloration of normal potatoes is induced by contact with iron during boiling.

Conditions during the growth of potatoes are said to affect darkening. Parker (5) stated that soil conditions were more important than the variety of potato. Findlay (3) Merkenschlager (4) and Tottingham, Nagy, and Ross, (9) concluded that blackening was greater when the potash content of the soil was low. Nitrogenous fertilizers tended to aggravate this abnormality of the potato (10). On the other hand Smith, Nash, and Dittman (7) showed that varying levels or combinations of various levels of nitrogen, phosphorus, potassium, lime and manure had no consistent or predictable effect upon the occurrence of blackening, except as they may have altered the stage of maturity with reference to weather conditions, particularly temperature. Likewise they found that soil reaction, soil moisture, soil type, and deficiencies of boron, copper, zinc, manganese, and magnesium had no noticeably consistent effect. According to Tottingham, Nagy, and Ross (9) neither maturity, storage, temperature nor ventilation was a primary factor in the discoloration.

Susceptible potatoes may be prevented from discoloring by soaking the raw pared tubers for 2.5 hours in water or by boiling in acidified water.

Because of the inconsistency of the literature with respect to the factors affecting tuber blackening after boiling and because consumers discriminate against such potatoes, the following experiments were conducted.

EXPERIMENTAL

Samples of Russet Rural, Green Mountain, Sebago, and Chippewa varieties of potatoes consisting of five potatoes each were obtained from 100-pound lots entered by Michigan growers in potatoes shows at Marquette, Petosky, and Edmore, Michigan. In January the potatoes were washed, dried, weighed and quartered. One stem-end quarter was plugged, the plug immersed in alcohol (11) and the discoloration rated. The remainder of the quarter was steamed by autoclaving for 5 minutes.

at 15 pounds pressure and observed after 0.5 hours for discoloration. The rating scale used ranged from 8 with no discoloration to 3 with intense blackening. Since the degrees of discoloration by the two methods were practically identical, only the data on steaming is given. The other stem-end quarter was weighed in a tarred crucible, dried in an oven at 100°C. overnight for determination of moisture and ashed in a muffle overnight at 550°C. After weighing, the ash was dissolved in dilute HCl and made up to volume. Aliquots were used to determine iron by the *o*-phenanthroline method (1) and manganese by the periodate method (12).

In the case of Green Mountain and Russet Rural, there were sufficient potatoes grown in restricted areas to permit segregation as to location. In these instances potatoes grown within a 20-mile radius were treated as a group as well as combined in the total for all areas.

RESULTS

Table 1 gives the results of the chemical analyses. The average discoloration for the Sebago variety was similar to that for the Chippewa, and the discoloration for the Green Mountain variety was about the same as for the Russet Rural. The latter two varieties, however, discolored much more than the former.

Correlation coefficients between discoloration and the other constituents were determined statistically with the individual items. It was found that the correlation coefficients between discoloration and the moisture content within the particular lot was statistically significant to highly significant but between varieties, this correlation did not seem to hold. For example, the Chippewa discolored the least yet contained the highest moisture content. There was a significant relation between the darkening and the ash content for the Green Mountain variety, manganese for Chippewa, iron for Sebago and Chippewa, pH for Green Mountain and Russet Rural, weight for Chippewa. Again these relationships existed only within the lots.

Simple correlation coefficients were also computed between the following: pH and moisture, ash, manganese, iron; moisture and manganese, iron; ash and manganese, iron. Multiple correlation coefficients were likewise obtained between discoloration, moisture and pH; moisture, manganese and iron; ash, manganese, and iron. Correlation coefficients for moisture and pH, and discoloration, moisture, and pH were highly significant for all varieties except the Sebago. None of the others was significant.

TABLE 1. *The average composition of different varieties of Michigan potatoes and their discoloration after cooking.*

Variety	Location Grown	Number of Potatoes	Dis-coloration	Moisture	Ash	Manganese	Iron	pH	Weight	Grams
										Per cent
Sebago	Upper Peninsula	29	7.5	77.2**	1.06	0.83	3.46***	6.27*	175	
Chippewa	Upper Peninsula	32	7.4	80.6***	0.85	1.79**	3.52***	6.05	160**	
Green Mountain	Republic, Mich.	33	6.6	78.3*	0.77***	1.07	3.45	6.11	186	
Green Mountain	Upper Peninsula	80	6.6	78.2***	0.79***	1.04	3.42	6.06***	175	
Russet Rural	Rock, Mich.	70	6.5	76.2**	0.93	0.81	3.83	6.07	154	
Russet Rural	Manistique, Mich.	23	6.7	76.4***	0.86	0.75	3.50	6.10***	159	
Russet Rural	Edmore, Mich.	32	6.5	77.0*	0.95	0.70	3.60*	6.05	170	
Russet Rural	Upper and Lower Peninsula	144	6.5	76.2***	0.92	0.76	3.72	6.18**	161	

***, **, * Correlation coefficient between discoloration and item starred significant at the one per cent level, at the five per cent level, and almost significant at the five per cent level, respectively.

DISCUSSION

Although moisture is highly significant with respect to the degree of blackening of the four varieties of potatoes when drawn from the same lot, the correlation is not evident when comparison is made between tubers from different varieties. This indicates that, whereas the moisture content is dominant, other factors are involved, but their role is minor or obscure.

The pH is next in importance to moisture in producing discoloration which increases as the pH decreases. This may be due to hydrolysis of some constituent, such as sugar, which can then combine with the proteins to produce darkening. It should be borne in mind that this is separate and distinct from the reaction obtained by soaking or boiling the tubers in acidified water, which may extract the offending materials from the potato tissues.

The evidence points to an effect of moisture and pH upon some unknown constituent or constituents on which the degree of darkening is more directly dependent.

SUMMARY

Moisture, ash, manganese, iron and pH were determined on Sebago, Chippewa, Green Mountain, and Russet Rural varieties of Michigan-grown potatoes and correlated with the degree of discoloration obtained after steaming.

The correlations between discoloration and moisture, between moisture and pH and between discoloration, moisture and pH were all highly significant within lots. That between discoloration and pH was significant within some lots. The discoloration increased with increased moisture and decreased pH.

The study indicates that moisture is a dominant factor in discoloration of cooked potatoes but its influence is upon some more directly involved component.

ACKNOWLEDGMENT

The authors acknowledge the advice of Dr. W. D. Baten on the statistical treatment of the data.

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ASSOCIATION OF SPECIFIC GRAVITY WITH DRY-MATTER CONTENT AND WEIGHT OF IRISH POTATO TUBERS¹

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Recently the specific gravity of tubers of Irish potatoes has received considerable attention as an index of dry-matter content and cooking quality. In experimental work it is generally recognized that high specific gravity of tuber is positively associated with high cooking quality and high dry-matter content. The literature dealing with this subject has recently been reviewed by Dunn and Nylund (3).³

The present study was made to determine the relationship of variety and location to the association between specific gravity and dry-matter content, specific gravity and weight, and dry-matter content and weight.

This study included 50-tuber samples of the Houma and of the Green Mountain varieties; one sample of each was harvested at Baton Rouge, Louisiana in June 1945, and one of each at Crossville, Tennessee in August 1945.

The specific gravity of each tuber was determined by immersion in salt solutions of different concentrations, as used by Clark, Lombard, and Whiteman (2), and others. Subsequently each tuber was washed, numbered, weighed, and sampled for dry-matter content. For

¹Cooperative investigations by the Division of Fruit and Vegetable Crops and Diseases, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, United States Department of Agriculture, and the Louisiana Agricultural Experiment Station.

²Pathologist, United States Department of Agriculture; stationed at Baton Rouge, Louisiana.

³Figures in parentheses refer to "Literature Cited".

TABLE I.—Frequency distribution, based on specific gravity determinations of tubers of Green Mountain and Honma varieties of Irish potatoes grouped according to the respective dry-matter content. Tuber grown at Baton Rouge, Louisiana and, Crossville, Tennessee, in 1945.

Range of Dry Matter Content Per cent	Specific Gravity ¹			Weighted Average Specific Gravity
	Green Mountain	Louisiana	Honma	
17.01 — 18.00		1.055 (7)		1.054 (2)
18.01 — 19.00		1.056 (12)		1.059 (6)
19.01 — 20.00	1.064 (3)	1.061 (18)	1.060 (2)	1.057 (18)
20.01 — 21.00	1.066 (14)	1.064 (11)	1.067 (5)	1.063 (47)
21.01 — 22.00	1.069 (12)	1.064 (2)	1.070 (4)	1.065 (42)
22.01 — 23.00	1.074 (15)		1.075 (14)	1.068 (23)
23.01 — 24.00	1.078 (6)		1.080 (13)	1.074 (29)
24.01 — 25.00			1.081 (10)	1.079 (20)
25.01 — 26.00			1.083 (2)	1.081 (10)
				1.083 (2)

¹The numbers in parentheses refer to the number of tubers in each class.

the determination of dry-matter content, each tuber was grated over a kitchen vegetable grater, the resultant mass of fine pulp being thoroughly mixed, and two 10-gram samples of this pulp were weighed into small metal cans equipped with tightly fitting lids. Into each can enough 95-per cent alcohol was added to cover the mass of pulp. The samples were then dried in an oven at 95° F, for 48 hours after which the dry weight was determined.

EXPERIMENTAL RESULTS

The data in table 1 show the relation between specific gravity and dry-matter content of Green Mountain and Houma at both Baton Rouge, Louisiana, Crossville, Tennessee. These results agree with those presented by other workers in that the specific gravity increased as the dry-matter content of the tubers increased.

A rather definite differential location effect, as regards the relation between specific gravity and dry-matter, existed with Green Mountain, and to a lesser degree, with Houma. This is apparent, for example, with Green Mountain because more tubers at Crossville, Tennessee, occurred in higher specific-gravity groups than at Baton Rouge, Louisiana. This difference probably is because the greater rainfall at Baton Rouge resulted in higher moisture content of tuber with subsequently lower specific gravity values.

The linear correlation coefficients between specific gravity and dry-matter content, as indicated in table 2, varied from +0.81 to +0.85 for the two varieties at the two locations. These values compare closely with a correlation coefficient of +0.82 reported by Bewell (1) and of +0.87 recently reported by Dunn and Nylund (3).

TABLE 2.—*Correlation coefficients for comparisons of specific gravity, dry-matter content, and weight of tubers of Green Mountain and Houma varieties of Irish potatoes grown in Louisiana and in Tennessee in 1945.*

Comparisons	Correlation Coefficients in—			
	Louisiana		Tennessee	
	Gr. Mt.	Houma	Gr. Mt.	Houma
Specific gravity <i>vs.</i> dry matter	+0.82**	+0.83**	+0.85**	+0.81**
Weight <i>vs.</i> dry matter	-0.13	+0.03	-0.10	-0.08
Weight <i>vs.</i> specific gravity	-0.22	+0.01	+0.07	-0.19

**Highly significant

No previous work of this kind has been done with more than one variety at a time. The four correlation coefficients for the comparison of specific gravity and dry matter are not significantly different (table 2). Thus, it is apparent that soil and climatic conditions for plant

growth in this instance did not materially influence the relationship between specific gravity and dry-matter content of potato tubers. Furthermore, insofar as the 2 varieties were concerned, the relationship was practically the same for each one.

Neither specific gravity nor dry-matter content was significantly correlated with weight of tuber. This was true with both varieties in the two locations. This is borne out by the data in table 2 in which case all of these correlation coefficients were of a very low value and non-significant.

SUMMARY

Specific gravity and dry-matter content determinations were made on 50 tubers of both varieties of Irish potatoes grown at Baton Rouge, Louisiana, and at Crossville, Tennessee.

The degree of relation between specific gravity and dry matter was indicated by a linear correlation coefficient of +0.81 to +0.85.

Soil and climatic conditions for plant growth did not materially influence the relationship between specific gravity and dry matter. The relationship was practically the same for each of the 2 varieties tested.

Neither specific gravity nor dry-matter content was significantly correlated with weight of tuber. This was true for both varieties in the two locations.

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THE USE OF ETHYLENE CHLOROHYDRIN FOR BREAKING THE REST PERIOD OF LARGE QUANTITIES OF POTATOES

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INTRODUCTION

Denny³ of Boyce Thompson Institute developed a treatment with ethylene chlorhydrin to hasten the germination of dormant potato tubers, thus securing plants from recently harvested potatoes much sooner than would have been possible otherwise.

¹Program Director, Maine State Seed Potato Board.

²Associate Entomologist, Maine Agricultural Experiment Station.

³Denny, F. E. Hastening the sprouting of dormant potato tubers. *Amer. Jour. Bot.* 13:118-125. 1926.

Following a severe epidemic of leafroll in 1937, seed potato growers in Maine realized the importance of securing advance information on the desirability of particular seed stocks for further propagation as has been secured for a number of years in other states,—notably New York.

Since Denny's work had been confined to small quantities of potatoes for use in experimental studies, his method was not readily adaptable where carload lots of potatoes were involved. Such adaptation has been made in Maine. The experience gained here in treating large quantities of potatoes may be of considerable value to officials in other states, where advance testing of seed stocks is gaining favor as time goes on. The method described below has proven to be a successful one for securing advance information on the virus content of seed stocks by the 25th of January from samples of tubers harvested (in Maine) as late as early October of the previous year.

METHODS AND PROCEDURE

Chambers. Two types of gas chambers have been available for the work. One type was built originally as a cold-storage locker. A number of such lockers were constructed in an underground potato storage cellar and were thoroughly insulated with cork. Each is approximately 11x12x10 feet in size. All of them have tightly fitting doors and false floors to facilitate air circulation.

The other type of chamber was constructed by partitioning off a part of the building immediately above the lockers already described. The rooms are not so tight as the ones below, although all wall space is insulated with ground cork. The rooms have outside windows which are covered with panels of plywood during the gassing period. They are approximately 14x16x9 feet in size.

Arrangement of Potatoes in Gas Chamber. Experience has indicated that the arrangement of the sacks in the gas chambers has a bearing on the results secured. All samples to be treated are first placed in sacks made from 10-ounce burlap. In so far as possible all samples of each variety of potatoes are grouped in a chamber by themselves,—for reasons to be stated later. The first row of sacks on the floor is placed leaning against the back wall at an angle of 30 to 40 degrees to allow for air circulation along the row back of the sacks, with an interval of one foot between each end of the row and the side wall. Succeeding rows on the floor are placed as snugly as possible one against the other. Meanwhile a second tier of sacks is placed on the first, the first row again at an angle against the back wall and the others fitted

snugly. If a third tier is needed it is placed similarly. In piling the sacks as indicated, the shape of the sacks will provide sufficient space between tiers of sacks for proper circulation.

Heating and Air Circulation. Since preheating of the potato samples is necessary before gassing is started and because the potatoes must be kept warm during the 5-day gas treatment, heating equipment was installed in each of the chambers used. Electric fin strip heaters are used with continuously operating electric fans to dissipate the heat from the strips and to help circulate the air in each room. Automatic control of the temperature is obtained by means of thermostats. It is believed that steam or hot water heat would be equally satisfactory for this purpose.

It has been found necessary to provide for additional air movement, especially when 200 to 550 95-pound sacks of potatoes are placed in a chamber, and the chamber is nearly filled. To assure sufficient circulation, a fan capable of moving about 2,000 cu. ft. of air per minute has been found most satisfactory. These larger fans are used to circulate the air throughout the preheating and gassing period.

Gassing. The ethylene chlorohydrin is introduced when the potato samples in the gas chamber have been brought to a uniform temperature of 75° to 80° F. During the early part of the 5-day treatment, the anhydrous chemical is diluted by adding 6 parts of water to 4 of the chemical by weight. It has been found in using the diluted gas that the humidity in some of the gas chambers rises to the saturation point on the second or third day of the treatment. If this condition occurs it is far easier to evaporate the anhydrous chemical than to continue the use of the diluted material.

An attempt is made to have the ethylene chlorohydrin evaporating throughout the 5-day treatment. Evaporation is aided by placing toweling in front of the fin strip heaters, behind which are the fans used to dissipate the heat. The toweling is hung from the ceiling of the chamber and dips into a pan container into which ethylene chlorohydrin is poured from time to time. Glass containers are most practical for this purpose.

The amount of gas needed is determined by the weight of the potatoes in each chamber. The potatoes are weighed just before being placed in the chamber.

The present practice is to assure the evaporation of one quart of 40 per cent ethylene chlorohydrin to every 600 to 720 pounds of potatoes. The gas treatment is continued until this amount has evaporated or until 5 days have elapsed. In most instances these 2 events

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coincide reasonably well. Considerable attention must be given to each gas chamber during the treating period. If the temperature of the bin is found to be rising above 82° F. due to physiological activity within the tubers, or when the humidity rises to the saturation point, it is desirable to provide outside ventilation. This may be done by opening the door of the gas chamber a few inches for a period of 5 or 6 hours,—depending on conditions.

Although blackheart has never been evident in potatoes treated by this method, failure to provide adequate outside ventilation at intervals may bring about such a condition. The temperature of the gas chambers should not be allowed to rise above 82° F.

The gas chambers are ventilated for a period of 12 hours after the 5-day treatment. The gassed potatoes are then kept at a temperature of 75° to 78° F. until loaded for shipment to Florida. This is usually for a period of 2 or 3 days.

The potato samples are shipped to Florida in refrigerator cars. Before loading the samples from the gas chambers, the cars are heated to a temperature of 80° F.

Varietal Reaction. Growth of plants in Florida has indicated, on numerous occasions, that there is a great deal of difference in the reaction of certain varieties to the ethylene chlorhydrin treatment. Most of the commercial varieties grown in Maine are successfully handled by a single 5-day treatment. However, Cobbler and Russet, among the older varieties, and Mohawk, among the newer varieties, have proved to be more difficult to gas effectively. This difficulty has been overcome by giving tubers of these varieties a second 5-day treatment after an interval of 12 to 15 hours. The chamber is thoroughly ventilated during the 12- to 15-hour interval between treatments. This amounts to doubling the quantity of ethylene chlorhydrin used but the uniform stand obtained in Florida amply justifies the extra effort and cost.

RESULTS

The basis on which the success of the gas treatment must be judged is the uniformity of the stand of plants in Florida and the rapidity with which they reach a size large enough to provide a sound basis for determining the amount of any virus disease that may be present. The tubers are planted whole.

Stand counts indicate that there is some difference between varieties but that better than 95 per cent of the gassed potatoes emerge and produce plants large enough to read for virus diseases by the end of

January. In 1945 the emergence of Irish Cobblers was 95 per cent; Chippewa, 96; Green Mountain, 95; Katahdin, 96; Sebago, 95; and Russet Rural 95 per cent.

Field counts to determine the percentage of virus have been made in a number of instances during several seasons. These counts indicate that the 5 per cent of the tubers that fail to produce plants in Florida do not differ materially in the percentage of infected tubers from the tubers that do produce plants. Hence the failure of some tubers to produce plants does not materially alter the reliability of the test from a grower's point of view.

The results based on the handling of approximately 3,000 bushels of potatoes annually have been satisfactory only when each variety is handled in the manner found best suited for breaking dormancy of that particular variety.

TABLE 1.—*The use of ethylene chlorohydrin for the breaking of dormancy in certain potato varieties.*

Variety	Kind of Chamber ¹	Amount of 40 per cent Solution of Ethylene Chlorohydrin	Duration of Treatment: Days ²
Chippewa Sebago	Either	1 qt. to 720 lbs. potatoes	5
Bliss Triumph Earlaine #2 Early Rose Green Mountain Houma Katahdin Pontiac Sequoia Teton B70-5	Either	1 qt. to 660 lbs. potatoes	5
Irish Cobbler Mohawk Russet Rural Warba	Tight	2 qts. to 660 lbs. potatoes	10 ³

¹If chamber is not filled, experience has indicated a need for $\frac{1}{3}$ more gas than the weight of the potatoes requires when a chamber is full.

²Temperature in all cases held between 75° and 80° F.

³Divided into 2 5-day treatments with an interval between for thorough ventilation of the chamber.

The data presented in table 1 were based on the results obtained from the treatment of approximately 5 freight carloads of potatoes in 1945.

SUMMARY

Results of treating about 3,000 bushels of potatoes a year with ethylene chlorhydrin to break the rest period have indicated that varietal differences exist, necessitating variations in the treatment of tubers to secure uniform results from the growth in Florida. When each potato variety is treated in a certain way with respect to temperature, ventilation, and liberation of ethylene chlorhydrin, 95 per cent of the tubers produce plants large enough to furnish a virus percentage reading by the end of January.

SECTIONAL NOTES

ALABAMA

The commercial potato growers in the counties of Baldwin and Escambia have been slow in indicating just how many acres they will plant this spring. This was probably due to the "wait and see what happens attitude" in regard to the Government support program. The allotted plantings for the two counties total near 17,000 acres with small plantings of under three acres in additional up to 4,000 acres. Most of the growers plant more than three acres and therefore will come under the allotment plan if they are to benefit from the support program. It is generally considered that Baldwin County will probably plant 14,000 acres and Escambia County will plant probably 3,500 acres. This total of nearly 18,000 acres is about 20 per cent less than last year's plantings.

It is estimated that 60 per cent of the potatoes will be Bliss Triumph and the balance Sebago. Seed is arriving in increasing amounts daily because of shipments before the 1st of January to avoid increase in railroad freight cost. Most of our seed will be in the county by the 10th of January. This will be a temptation for our growers to plant early, should springlike weather continue.

Most of our growers are worried about Late Blight and are preparing to either dust with copper-DDT or to spray with Dithane. Late blight is still being found on volunteer tomato plants in semi-protected field conditions. Although this may not be the same strain of the Late Blight, most of us feel that we will have Late Blight on potatoes as soon as conditions for its development appear. (Jan. 3).—FRANK E. GARRETT.

CALIFORNIA

All our potato growers have received their allotments from the County Committee—some are happy, some are satisfied, and some dissatisfied with the goals given them. Just what will take place with reference to actual acreage plantings is impossible to state at this time, but it appears that there will be a reduction under the large acreage produced in this county last year. (Dec. 23).—M. A. LINDSAY.

IDAHO

The condition of the Idaho crop that is in storage is rather poor in some sections. Many growers and dealers report that potatoes are deteriorating rapidly in some sections. Possibly this is due partly to field frost in some cases and in other cases to immaturity of the tubers as a result of vines being green and growing until harvest.

The harvest season was very difficult, with labor shortage, frosts and wet weather, which resulted in many potatoes being placed in storage in poor condition. All indications are that the shrinkage in storage will be considerably more than normal.

Meetings have been held with growers in all of the seed potato-growing areas of the state. Seed growers in all of these areas have expressed concern about the fact that the Government support program is not really of benefit to seed growers, since it is based on No. 1 and No. 2 grades and much of the seed produced is too small for these grades. This may have some effect on the seed potato acreage for 1947. (Dec. 30).—JOHN R. ROBERTSON.

INDIANA

Our potato crop has been disposed of and at a satisfactory price to the growers. We had an exceptionally fine crop,—good yields and good quality. Numerous growers on the muck soils averaged 500 bushels or more per acre of No. 1 quality. With good quality the growers found it easy to put up a good pack which they hope to maintain in the future. It appears that 3 per cent DDT put in the regular spray or dust program gave an estimated increase of 20 per cent more potatoes per acre.

The Katahdin, Irish Cobbler and Chippewa continue to lead all varieties. Our growers have not become favorably impressed with some of the newer introductions. The intentions for 1947 plantings will be about the same as the average for the past five years. (Dec. 27).

—W. B. WARD.

MAINE

Aroostook potato growers made approximately 2300 special loans and 3650 regular loans under the price support program. Only about one-half million bushels were stored in piles in the field and covered with straw, boughs and dirt. All of these have deteriorated beyond use. About ten million bushels were stored in temporary storage,—some of these were moved into regular channels of trade, to starch factories and alcohol plants, but about seven million bushels deteriorated beyond any useful need and were dyed and disposed of.

The support program is the only thing which keeps potatoes nearly at the support level. Most farmers have already offered 20 per cent under their December quota and are starting to offer 20 per cent in January. The hope of the industries is that these can be disposed of soon.

Meetings to explain the 1947 allotment program were very well attended and farmers are willing to accept the state allotment of 182,500 acres. The county committee will be establishing goals during January.

The seed market is dull with orders coming in slowly. Apparently buyers are waiting for allotments, waiting for the Florida Test or are just not going to buy. One surprising thing is the lack of orders for Chippewas. It would appear that this variety is losing favor in some states.

The Aroostook County Farm Bureau is calling a meeting of state and federal workers to discuss the ring rot situation,—which is serious,—with some table stock growers. (Dec. 31).—VERNE C. BEVERLY.

NEBRASKA

The Nebraska growers of certified potatoes harvested one of the largest crops on record. The total tonnage is second to the 1945 crop. The yield per acre exceeded the 1945 crop, and established a new high for certified potatoes. In a breakdown of the crop by varieties, the Bliss Triumph exceeded the record crop of 1945, and is the all-time record total production of that variety.

In view of record tonnages produced by the other states throughout the nation, the Nebraska growers are faced with difficulties in marketing their crop. They report that the first grade, that is, Blue Tag Certified, sells readily, but second grade packs are going begging, the same being the case with table stock potatoes shipped out of the state. Unfortunately, the grade-outs were higher than usual, owing to very unsatisfactory conditions at time of harvest. Nebraska growers

Record-Breaking Potato Yield Follows Use of Summers Fertilizer

Harvesting Record-Breaking Potato Crop
on Jacob K. Mast Farm



F. S. Bucher, County Agent, Lancaster County, Pennsylvania, and Jacob K. Mast, owner, with two potato pickers who helped harvest the record crop.

Jacob K. Mast, Caernarvon Township potato grower, is the new "Potato King" of Lancaster County, Pennsylvania with a recorded yield of 734.07 bushels per acre as checked by County Agent F. S. Bucher, who certified its accuracy to State authorities. A veteran potato grower, "Jake" Mast stated to John J. Gross, Summers' representative in Pennsylvania, as follows—"I have used Summers' Potato Fertilizer for the past ten years with excellent results, both with respect to yield and quality. My 1946 record-breaking potato crop was grown with Summers' 4-12-12 at the rate of 1000 pounds per acre applied in bands. With this background of performance, you may count on me continuing to use Summers' Fertilizers."

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were faced with rain, snow, cold weather, and a combination of the three during most of the month of October, so conditions were extremely poor. This resulted in a high percentage of mechanical injury that reduced the quality.

A strange situation exists in that potatoes graded out of a lot, when failing to make U. S. No. 1, instead of being U. S. No. 2, are usually unclassified, that is, they are so severely damaged they cannot go as No. 2 or Commercial Grade: This lowest pack, both table and seed, is going begging on the market, and much of it will probably wind up in stock feed before the crop is disposed of.

The growers of the late crop potatoes, seed and table, are having usual difficulties with shortage of cars. That has existed for the past three seasons. Receivers of certified seed potatoes in the south have ordered shipments to be made much earlier than usual. In this they hope to beat the car shortage that develops right after the first of the year, and obtain their seed needs. One of the largest distributors of certified potatoes in Nebraska reported in mid-January of 1946 that they were over 200 cars behind on shipments. This year they determined to avoid this by starting out shipments for Louisiana and Alabama that were normally moved in mid-January, as early as mid-December. The usual slack season around the Christmas holidays has seen the heaviest movement of seed potatoes in many years. Prices for the 1946 crop are about comparable to 1945 for the better grades. Lower grades are below the levels set a year ago. Most of the prices are at Government support or above. The Government loan program is in effect, but covers only a small portion of the crop, part of which is being moved at this time.

Planting indications for next year are still rather indefinite, however, their is expectation of a slight decrease. The allotment program asks for a slight decrease, and this will probably be met. (Dec. 26).—MARX KOEHNKE.

NEW YORK

December has been a dull month as far as potatoes are concerned. We have had considerable winter weather since the first of the month which has curtailed a lot of truck deliveries. We understand that a car shortage exists in some of the sections that ship potatoes into our territory but we can see no evidence of a shortage of potatoes anywhere in our up-state markets. Prices have remained the same as during November, varying greatly in different areas but generally around \$2.00 cwt. Some truckers have, however, picked up good table stock at \$1.50 out of uninformed areas.



MODEL PB-3 WEED BURNER

The Model PB-3 is here shown in use in potato fields. Used to destroy green immature vines it permits harvesting operations without waiting for normal maturing of vines or their elimination by killing frost.

Vegetation which has accumulated after cultivating is no longer possible, is completely eradicated and permits efficient digger operation. Clean fields result in fewer potatoes being lost as they can easily be seen by pickers.

The use of the Model PB-3 is not restricted to the burning of potato vines as it can be used wherever weed eradication is necessary.

At a speed of 5 m.p.h. the Model PB-3 consumes 18 gallons of fuel oil per acre and burns 4 rows or a swath 15 feet wide on each trip.

References by potato growers using the Model PB-3 furnished on request. They will give you their actual experience with the use of this machine.

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Division of Plant Industry

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KATAHDINS
SEBAGOS

Seed inspection

SE BAGS
AND NINE
OTHER VARIETIES

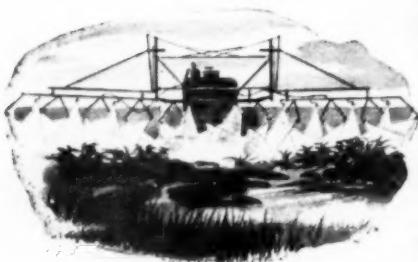
Final inspection

Write
Newdick, Chief,
E. L. Newdick, Chief,
Division of Plant Industry,
Maine Department of Agriculture,
Maine House, Augusta, Maine.
State House, Augusta.

A black and white graphic logo for "STATE of MAINE CERTIFIED SEED POTATOES". The text is arranged in three horizontal bars. The top bar contains "STATE of MAINE" in a bold, sans-serif font. The middle bar contains "CERTIFIED" above "SEED" in a bold, sans-serif font. The bottom bar contains "POTATOES" in a bold, sans-serif font. The bars are slightly angled and overlap each other.

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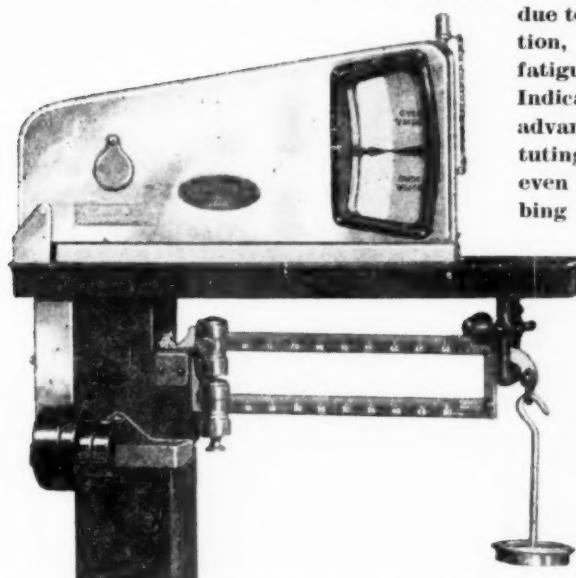
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We understand there was quite a rush for coverage under the support program during the last week of its availability and we hope enough potatoes are covered to bring the market level somewhere near the support prices after the first of the year.

Seed growers are quite concerned because of the slow movement and also inquiries regarding certified seed. Apparently buyers of seed have their cellars full and are in no hurry to get covered on spring requirements. Some have expressed their thought that potatoes would be cheaper in March but it is the opinion of our growers that with the big shrinkage being noted in various areas and the high percentage under the support program that good seed will tend to be scarce rather than plentiful. Many of our growers have oversize seed which will go to the table stock market but the grower who has high quality medium size seed is holding for a considerable premium over the support price. (Dec. 19).—H. J. EVANS.

NEW YORK

This is the time of year when potato growers are considering plans for another year but have not yet made definite decisions. Government acreage control and price support programs will have some influence on the 1947 acreage. With a 1946 crop of 42,570,000 bushels which is 52 per cent above the 5-year average and 47 per cent above 1945, growers do not anticipate much improvement in the spring market.

It has been estimated that between 2 and 3 million bushels of the big Long Island crop are still in piles in the field. Most of these are under government loan and may or may not be fit for any commercial use. The exterior of most of these piles has been frozen and it is not known whether the interiors are sound.

Results of the 8 farm bureau potato variety trials have been summarized and are being publicized. Among the newer varieties which performed well enough to put them into commercial production in upstate New York are Virgil, Placid, Erie, Ontario, Mohawk and Teton. As a group these are likely to supersede largely the old Rural. Russet Rural, probably because of its popularity for chip-making is holding on better than the smooth-skinned Rural. Katahdin and Green Mountain are maintaining their popularity well, especially Katahdin upstate and Green Mountain on Long Island. Even though Katahdin seldom yields as well as most other main crop varieties, it is a fairly "sure-cropper," stores and sells well.

The 12th joint annual meeting of the Empire State Potato Club and the New York State Vegetable Growers' Association was held

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at Rochester on the 9th and 10th of January. Here our growers held their annual potato show, discussed the progress of our potato research program, and also federal control of acreage and prices in 1947. (Jan.)—E. V. HARDENBURG.

OREGON

The Oregon potato production for 1946 is estimated at 13,000,000 bushels compared with 12,324,000 bushels in 1945, and a 1935-1944 average of 7,574,000 bushels. It is estimated that approximately 2,500,000 bushels of potatoes were put under loan by Oregon producers this fall. The farm prices for potatoes during October and November were \$1.30 per bushel; during July, August and September they were \$1.35 per bushel.

A considerable portion of Oregon potato production is seed potatoes and growers have been concerned with the effect the 1947 support program would have on 1947 planting of potatoes and demand for seed.

The planting of samples from all certified and foundation lots of potato seed was made during the week of December 1 in the test plots at Oceanside, California.

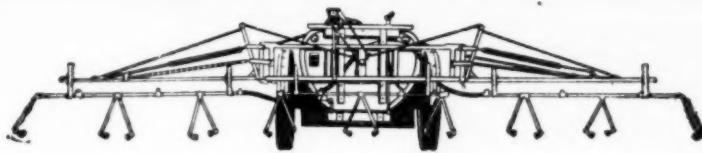
Information revealed at the Oregon Seed League annual meeting showed that the quality of russet seed potatoes has been seriously affected by leafroll. Two-thirds of all russet acreage entered for certification in 1946 was rejected because of leafroll. There are very few foundation seed growers of russets and more are needed. White Rose seed showed a decrease of disease in 1946. There are a good number of foundation White Rose growers.

The leafroll¹ causing so much difficulty is thought to be a more virulent strain of leafroll or a different but very similarly appearing disease. (Dec. 16).—W. G. NIBLER.

WASHINGTON

Mr. Charles D. Gaines, who has resigned his position as Supervisor of the Seed Division for the Washington State Department of Agriculture has been with the Washington Co-Operative Farmers' Association at Mt. Vernon, Washington, since last February. Potato certification is now being carried on under the supervision of Harold S. Schaad who has been with the Division for the past three seasons. He is assisted by two well qualified potato specialists, Paul A. Fraser and Henry C. Williamson, both veterans of World War II. All three men are graduates of Oregon State College with seed growing experience.

With the fine results obtained from greenhouse testing seed po-



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tatoes this fall buyers are becoming very much interested in Washington seed. The reason for the fine seed grown is attributed to the excellent plot-tested disease-free foundation seed stock used last spring. It is estimated that seed harvested this fall has 95 per cent less leafroll and mosaic than the crop harvested in 1945. All seed stock harvested is grown in bacterial ring rot-free areas. Ring rot has not been a factor in growing Washington certified seed potatoes. The growers can well be complimented for this wonderful accomplishment during 1946.

For the past season plans have been underway to greenhouse test immediately after harvesting the crop. The growers feel that buyers are entitled to know the approximate percentage of tuber-borne virus that the seed carries. This next season (1947) the Washington Department of Agriculture plans to have under greenhouse test every lot of seed potatoes produced. These tests will be under the supervision of the inspectors. These results will provide an index of the approximate amount of virus in each lot grown. The results should be available for the White Rose and other early varieties by the first part of November and December for the Netted Gem or late planted varieties.

This past season the inspectors made a special effort to personally field sample for outdoor plot and greenhouse testing, each lot of seed potatoes grown. This field sampling was done approximately 10-14 days after the vines were killed by the use of calcium cyanamid, frost or various chemicals. From information gathered from the test plots in 1945 it was found that in order to obtain a fair and complete test of the amount of tuber-borne virus the vines must be completely killed at sampling time. It was found that field sampling after the vines were completely dead gave better and more accurate results than any other method used. It is our experience that it is impossible to secure a representative sample from potatoes stored in a bin or sacks. This season the inspectors traversed the fields in the form of an X taking one tuber from each hill. Two hundred and ten tubers were taken from two to four ounces in size from each field of 20 acres or fraction thereof, in the case of larger fields an additional sample was taken for each additional 20 acres.

We have also found that for early outdoor test plot work it is best to use single drop seed from 1 to 2 ounces rather than tubers larger cut in two's and planted in units. It seems that the cut tubers break down more readily after gassing with anhydrous ethylene chlorhydrin. This is especially true when the soil is cold for a week or more after planting.

The samples from fields that were eligible for foundation from

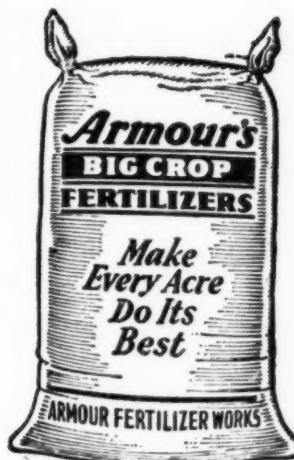


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past season's performance and field inspection tolerances were tested in the greenhouse. Duplicate lots were planted in the Oceanside, California, plots. Foundation rating will be given only to those lots that pass the field inspection standards and test plot tolerances set up in the certification regulations. By this method of tagging growers will be able to sell seed as foundation which will perform for the buyer as represented by the seal and certification tag attached. This method of certification will assure the buyer of good quality, dependable seed.

This season the Washington seed potato growers have 162 samples planted in four acres of plots at Oceanside, California. These plots were planted on the 8th of November and it is planned to have the disease readings by the 1st of February. The plots represent samples from 63 growers of the following varieties: White Rose, Netted Gem, Sebago, Bliss Triumph, Irish Cobblers, Gold Coin, Beauty of Hebron, Katahdin, Burbank and Earliest of All. There were 1,539 acres that passed the field inspection of which 60 per cent were White Rose, 36 per cent Netted Gems and 4 per cent other varieties. (Dec. 31).—HAROLD S. SCHAAD.

Most of our growers are a bit undecided about next year's production. Our seed growers are holding most of their crop,—subject to the Southern California test plots. These readings will not be available, probably, until February.

Our disease control problem has been definitely on the increase and the buying market is much more critical of the condition of seed potatoes purchased. With the general potato situation being less bright, it seems likely that both seed potato acreage and commercial potato acreage will be reduced in Washington in 1947. (Dec. 24).—CHAS. D. GAINES.

REPORT OF THE THIRTIETH ANNUAL MEETING OF THE POTATO ASSOCIATION OF AMERICA

The thirtieth annual meeting of the Potato Association of America was held in the Roosevelt Room, Hotel Morrison, Chicago, from December 2 to December 4, 1946. President E. B. Tussing of Ohio presided. E. L. Newdick of Maine was asked to serve as Secretary for the meetings. The meetings were well attended, with nearly 100 present, and the reports presented were of great interest. These reports

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**SULPHATE OF
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by Ora Smith and W. C. Kelly, Department
of Vegetable Crops, Cornell University. Reprinted from April, 1946,
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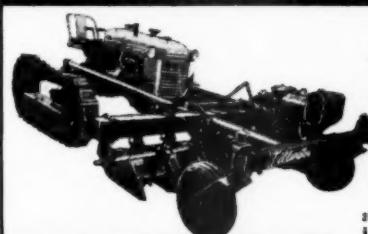
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will be printed in the American Potato Journal from time to time during the year.

The following officers and members of the Executive Committee were elected to serve for 1947:

Marx Koehnke, *President*—Nebraska Certified Potato Growers, Alliance, Nebraska.

W. N. Keenan, *Vice-President*—Department of Agriculture, Ottawa, Canada.

Wm. H. Martin, *Secretary-Treasurer, Editor*—Agricultural Experiment Station, New Brunswick, New Jersey.

H. A. Reiley—Michigan Potato Growers' Exchange, Cadillac, Michigan.

Frank Garrett—Department of Agriculture, Fairhope, Alabama.

O. D. Burke—Pennsylvania State College, State College, Pennsylvania.

Reiner Bonde—University of Maine, Orono, Maine.

George List—Colorado Agricultural and Mechanical College, Fort Collins, Colorado.

The following committee was appointed to serve throughout the meetings:

Nominating Committee—A. G. Tolaas, H. J. Evans, H. O. Werner.

Report of the Committee on Resolutions

We, the members of the Potato Association of America, at our thirtieth annual meeting, wish to commend Drs. W. H. Martin and Elizabeth S. Clark for the excellent manner in which they have conducted the affairs of the association and the American Potato Journal during the recent difficult years, and we hereby wish to express our appreciation for this loyal service.

Resolved, that the Executive Committee communicate with others interested in the potato industry with a view of developing an overall coordinating agency.

Resolved, that we express our thanks to Bruce Jones for his services and untiring efforts in helping to arrange for this meeting.

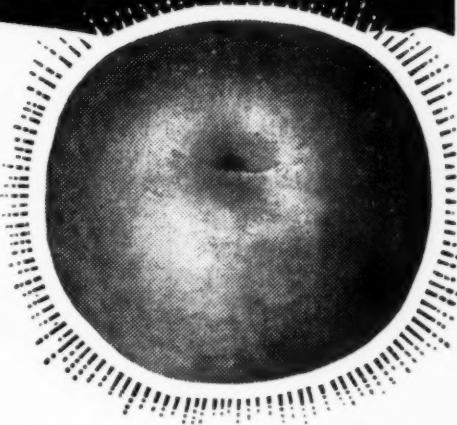
After some discussion of a meeting place for next year, it was agreed that this should be decided by the Executive Committee. It was also agreed that the newly elected Executive Committee should take the necessary steps to revise the constitution and by-laws of the Potato Association.

The report of the Secretary-Treasurer was read and approved.

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Report of the Secretary-Treasurer

When your secretary-treasurer took the oath of office in 1933, the membership in the Potato Association of America numbered 322. There has been steady but slow growth over the years, with a membership of 2,152 in 1946. It is of interest to note that Canada has 55 members, England 30, Russia 33, South America 30 and other foreign countries 43. There is reason to believe that the number of foreign subscriptions will increase in the next several years.

Here at home, the states with the largest memberships are North Dakota, New Jersey, New York, Washington and Minnesota. This, of course, results from the fact that these states have taken out group subscriptions. It is unfortunate that some of the other important potato-growing states, including Maine, Pennsylvania, Idaho, and Michigan have so few members in relation to the size and importance of the industry.

The financial condition of the association is excellent. As will be seen from the treasurer's report, we have a balance of \$1,986.32 on hand as of November 20, 1946.

When your treasurer took over, the association had a balance of \$264.78. Unfortunately, before the transfer of these funds was made, the Michigan bank in which they were deposited closed its doors. We are happy to report, however, that the final payment on this account was made in 1944. At the close of our first year of operation, we showed a balance of \$31.12. Times were bad and by 1941 the balance amounted to only \$10.98. At the same time, we were advised by the printer that we owed him approximately \$900.00. By cutting costs, by making a drive for additional advertising through employing Macfarland & Company of New York, and by increasing the number of subscribers, we managed to pay all outstanding bills and now have a cash balance of nearly \$2,000. The financial situation of the association has never been so good.

Your editor has carried the responsibility for the Journal since 1932. It has required considerable time and some headaches. Without the fine assistance rendered by Dr. Elizabeth S. Clark, who handles the details of proof reading, checking manuscripts, etc., the job would be impossible.

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Powco Brand JP No. 25 is a liquid, water miscible DDT spray concentrate containing 25% by weight of technical grade DDT with a hydrocarbon solvent. JP No. 25 is easy to use, stable, bland in odor, light in color—high flash point. JP No. 25 works well in hard or soft water. Royalties paid by Powell.

JP 50

Powco Brand JP No. 50 is a micron sized DDT dust concentrate containing 50% by weight of technical grade DDT. It is ideal for the manufacture of finished dusts and is compatible with pyrethrum, rotenone, sulphur, coppers etc. It is a free-flowing dust of extremely fine particle size, colored red for identification and chemically standardized to assure high quality and maximum effectiveness.

JP 50W

Powco Brand JP No. 50W is a DDT wettable powder concentrate of extremely fine particle size containing 50% by weight of technical grade DDT. It is especially milled and processed with a suitable wetting agent so that the finished DDT concentrate mixes readily with water. JP No. 50W controls potato insects never before controlled. It is easy to use, compatible with most fungicides, blue in color and efficient in every respect.

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STATEMENT FOR 1945 AND THE YEAR ENDING NOVEMBER 20, 1946

<i>Receipts</i>	1945	1946
Balance from previous year	\$ 417.99	\$ 924.63
Annual dues	1,654.34	2,234.42
Sale of advertising	1,821.57	2,386.25
Sale of reprints	361.30	272.10
Miscellaneous	261.25	191.42
 Total Receipts	 \$4,516.45	 \$6,008.82
<i>Disbursements</i>	1945	1946
Printing and Mailing of Journal	\$2,575.00 ¹	\$2,871.67 ²
Reprints	211.93	311.00
Postage and Supplies	250.40	316.15
Miscellaneous	14.49	23.68
Secretarial Work	300.00	300.00
Stenographic Service	240.00	200.00
 Total Disbursements	 \$3,591.82	 \$4,022.50
Bank Balance	924.63	1,986.32

¹13 issues, Dec., 1944-Dec., 1945, incl.²9 issues, Jan., 1946-Sept., 1946, incl.*Accounts Receivable*

Advertising—September and October.

Accounts Payable

Issue—October, 1946.

Report of the Auditing Committee

We, the undersigned Auditing Committee, have examined the books of the Potato Association of America and have found them to be correct.

(Signed) JOHN C. CAMPBELL,
RUSSELL E. LONG,
MILTON A. SPRAGUE.

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**STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC.,
REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912.**

Of American Potato Journal, published monthly at New Brunswick, New Jersey, for Jan. 1, 1947.

State of New Jersey ss
County of Middlesex ss

Before me, a Notary Public in and for the state and county aforesaid, personally appeared W. H. Martin, who having been duly sworn according to the law, deposes and says that he is the Editor of the American Potato Journal and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 411. Postal Laws and Regulations, printed on the reverse of this form, to-wit:

1. That the names and addresses of the publisher, editor, managing editor, and business managers, are:

Publisher—Potato Association of America, New Brunswick, New Jersey.
Editor—W. H. Martin, New Brunswick, New Jersey.

Business Manager—W. H. Martin, New Brunswick, New Jersey.

2. That the owner is: (If owned by a corporation its name and address must be stated and also immediately thereunder the names and addresses of stockholders owning or holding one per cent or more of total amount of stock. If not owned by a corporation, the names and addresses of the individual owners must be given. If owned by a firm, company, or other unincorporated concern, its name and address, as well as those of each individual member, must be given).

Potato Association of America, New Brunswick, New Jersey.

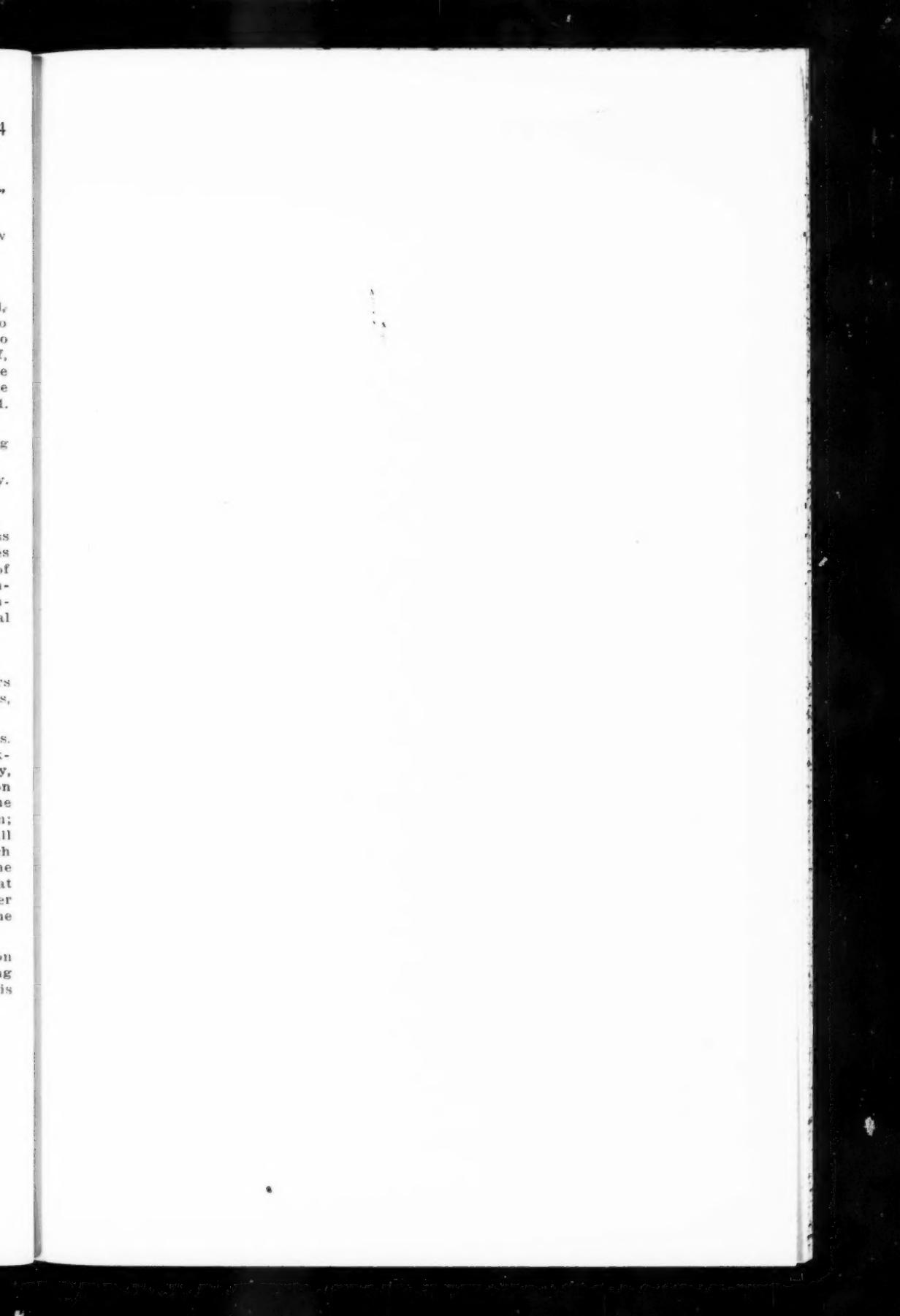
3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state). None

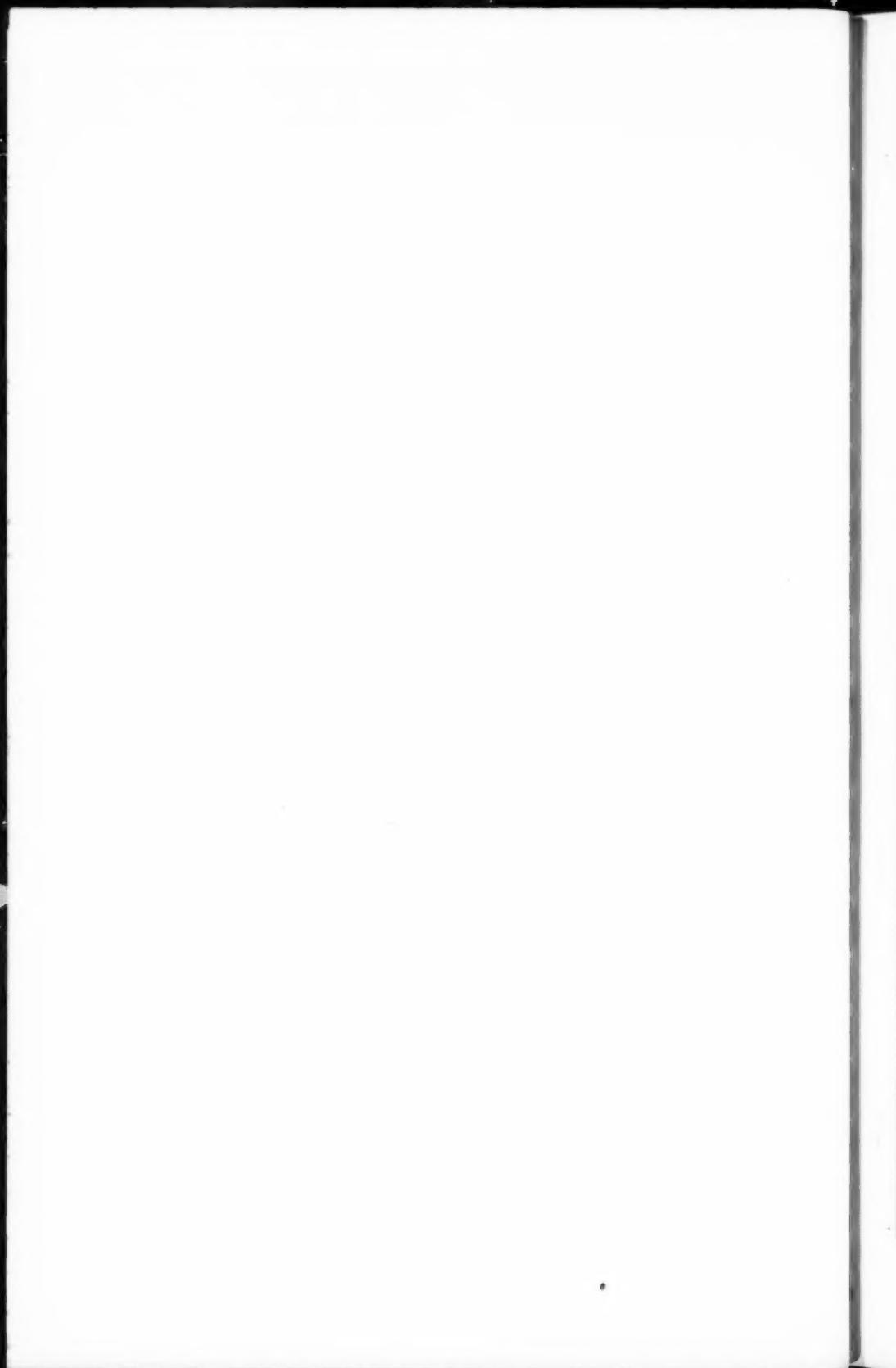
4. That the two paragraphs next above, giving the names of the owners, stockholders and security holders, if any contain not only the list of stockholders and security holders as they appear upon the books of the company, but also, in cases where the stockholders or security holders appear upon the books of the company as a trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities, in a capacity other than that of a *bona fide* owner and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is—(This information is required from daily publications only).

W. H. MARTIN, Editor.

Sworn to and subscribed before me this 1st day of January, 1947.
R. E. Long, Notary Public, Middlesex County, New Jersey.
(My Commission Expires January 31, 1949).
Form 3526—Ed. 1924.





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